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Discussions

Interactive comment on "Intensively exploited Mediterranean aquifers: resilience and proximity to critical points of seawater intrusion" *by* K. Mazi et al.

Anonymous Referee #1

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Review

of the manuscript by Mazi, Koussis and Destouni "Intensively exploited Mediterranean aquifers: resilience and proximity to critical points of seawater intrusion" submitted to HSE (2013).

The manuscript represents an explicit analytical solution to a steady-state, 1-D, Darcian flow of a constant-density fresh water over a sloping bed towards sea, from which a sharp interface tongue encroached the aquifer. The Dupuit-Forchheimer (DF) model is assumed. The flow domain with a gallery is divided into two subdomains: seabed-

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gallery and gallery-upstream boundary. The authors tackle the gallery as a given pumping rate sink, although a given constant head boundary can be also used for the gallery – similarly to the upstream boundary condition – with the flow rate from the gallery determined as a part of solution.

The novelty of this work is in extension of the paper published by the same authors in Journal of Hydrology in 2012.

My numerous technical comments are in the pdf file of the MS (attached). I also recommend to have a look at our papers on sea water intrusion in terms of both the DF and full potential model:

Kacimov A.R., Obnosov Yu.V. Analytical solution for a sharp interface problem in sea water intrusion into a coastal aquifer. Proceedings Royal Society London A, 2001, v.457, N 2016, 3023-3038.

Kacimov A.R., Obnosov Yu.V., Sherif M.M., Perret, J. Analytical solution to a sea water intrusion problem with a fresh water zone tapering to a triple point. J. Engineering Mathematics, 2006, v.54, N3, 197-210, DOI: 10.1007/s10665-006-9030-9.

Kacimov A.R., Sherif M.M. Sea water intrusion into a confined aquifer with controlled pumping: analytical solution. Water Resources Research, 2006, v. 42, No. 6, W06501 10.1029/2005WR004551

Kacimov A.R., Sherif M.M., Perret J.S., Al-Mushikhi A. Control of sea-water intrusion by salt-water pumping: Coast of Oman. Hydrogeology J., 2009, v.17, 541-548 DOI 10.1007/s10040-008-0425-8

We used both the DF model (Strack's comprehensive potential) and full 2-D potential model.

Mathematically, the authors introduced one more term $ i dh/dx$ (i=constant slope of the aquifer) into a nonlinear 2-nd order ODE. This "convective" term can be, mathematically, replaced by a more general term describing an arbitrary curvilinear bedrock

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boundary +interface (free boundary). Frankly speaking, in the 2000-th we also thought of solving the problem addressed in the reviewed MS, i.e. adding the convective term as the authors did. However, we decided not to do this because in Omani coastal aquifers affected by intrusion the bedrock is more complicated than just a planar tilted boundary (straight sloping line in a vertical cross-section). The bedrock in Oman has "troughs" and other inundations which "intercept" the sea water tongue.

In conclusion, I recommend a minor revision.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/10/C7685/2014/hessd-10-C7685-2014-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 13817, 2013.